"We summarize the results of the foregoing discussion in the following rules:

"1. The rule that a name once applied but later becoming invalid must not be used again is to be recommended for observance in the future; but retroactive force is to be denied to this rule (once a synonym always a synonym) and alterations of names based upon it are to be rejected.

"2. On the transfer of a species out of the original genus into another genus, the original specific name is to be retained.

"3. The year 1753 is to be retained as the starting point of priority for both species and genera.

"4. In the nomenclature of species the principle of priority is imperative; only a more certain name must not be replaced by a doubtful one.

"5. In the nomenclature of genera a name which has remained unnoticed for at least fifty years, cannot later be established in the place of one which has become current.

"6. This rule allows an exception where the name in question, since its restoration, has remained in use at least fifty years.

"These rules as well as all other proposals proceeding from the committee after they have been passed upon by the committee, require the approval of a future congress.

"It is much to be desired that botanical nomenclature be placed in the closest possible accord with the system of nomenclature now under deliberation by the zoologists.

"P. ASCHERSON,
"A. ENGLER."

"Vienna, September 21, 1894."

(*To be continued.*)

VEGETABLE PHYSIOLOGY.[1]

Macfarlane on Paraheliotropism.—As the result of a series of interesting experiments, described in *Botanisches Centralblatt*, Bd. 61, 1895, under the title of "The Sensitive Movements of some Flowering Plants under Colored Screens," Dr. J. M. Macfarlane, of the Univer-

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

sity of Pennsylvania, finds that the hot sun position assumed by sensitive plants is not due to the action of solar heat rays, as a number of observers have stated, and as he was himself formerly inclined to believe, but to the more refractive rays of the solar spectrum. His studies were made upon *Cassia nictitans, C. chamœcrista, C. tora* and *Oxalis stricta*, and some of his conclusions are as follows:

"In all cases it has been found that Sachs' statement is so far correct, viz.: that when sensitive plants are placed under colored screens the leaflets fold as in the nyctitropic state, most powerfully under red, less so under yellow, only feebly or not at all under green, and that under blue screens the leaflets remain open as in ordinary daylight. But expansion under the red and yellow screens soon takes place, the rapidity of the expansion varying according to the brightness of the light and the species experimented on." "If the light be diffuse, and thus of moderate intensity, the flat morning position of the leaves is retained throughout the entire day, or part of it if the sun ultimately shines out." "If the light becomes more intense, no alteration, or it may be slight deflection in *Cassia* or inflection in *Oxalis*, occurs to leaflets of plants under the red and yellow screens. When plants are under a green screen and exposed to intense illumination. the leaflets either remain flat or assume a more or less paraheliotropic position, the angular change at times amounting to 25°. In all cases under the blue screens the leaflets become paraheliotropic more or less powerfully, the amount of angular movement being proportioned to the intensity of the light. It is impossible at present to say whether the blue or violet rays are the more powerful. In all cases, normal nyctitropic movement is accelerated a half to one and a half hours under a red screen, but the movements of the leaves and leaflets then are very peculiar." "Under a yellow screen nyctitropism is not quite so accelerated as under red, but the closing movements are nearly or quite regular in sequence, and in Cassias are first visible at the leaf extremity. Under a green screen the time movement practically coincides with that of exposed plants, and is beautifully regular in sequence." "Under the blue light there is always a distinct retardation of the normal nyctitropic period to the extent of from ½ to 2½ hours, the variations seeming to depend on temperature, on length of exposure to the blue light, and on relative intensity of the light for the day." "These observations seem further to warrant us in concluding that up to 38° C., or even 43° C. in some species, heat rays either fail to stimulate the tissues, or if they do that, their action is interrupted aud antagonized by some other form of energy, though this is scarcely likely. The same is true

of the less refrangible light rays, and of these the orange-yellow, yellow and yellow-green seem to give the most uniform results, for so long as plants were exposed to intense light the leaflets remained either quite flat or became slightly reflexed. Under the green screen the leaflets of *Cassia nictitans* and *C. chamæcrista*, when strongly illuminated remained flat or became inflexed in some cases to 25°, but those of *C. Tora* under equal illumination inflexed through an angle of 15°; those of *Oxalis stricta* remained flat. The paraheliotropic movement thus started under the green screen in some species became greatly more pronounced under the blue in all, and during intense illumination in *Oxalis* almost amounted to the nyctitropic position. Grouping the above facts, the conclusion is reached that the heat rays, the less refrangible rays, and the more refrangible rays are all trophic up to a certain point. When that point is crossed the heat rays and less refrangible rays continue to be trophic up to a much higher point, but the more refrangible rays (from green-blue to violet) act as a stimulant or irritant." "It may be worth emphasizing here that sensitive movements are most pronounced in tropical plants, are less so in subtropical and warm-temperate species, and are rare or feebly expressed in temperate and sub-arctic plants. But, as is well known, leaves that are exposed to an intense light show more rapid metabolic changes than those that are shaded. Any change, therefore, in the tissues of a plant which would insure protection of the lamina from the intense blue-violet rays, and its exposure again when these rays become subdued, would have every likelihood of perpetuation in sub-tropical and tropical regions, and such is the state of matters as we find them. We do not know accurately, as yet, the mechanism involved in a sensitive pulvinus, or the changes effected on stimulation of it, but anyone can readily prove that every gradation from non-sensitive to highly sensitive leaves is met with in such groups as the Oxalideæ and Leguminosæ, and that, broadly speaking, the sensitiveness increases as we pass from regions where the sun's rays are of minor intensity to others where the rays are of increased intensity. The writer, therefore, regards the action of the more refrangible rays, when of a definite intensity, as one of stimulus, because (1) the angular inflection of leaflets is proportionate to the intensity of the stimulating rays; (2) the movement is not due to indirect action from the green laminar substance to the pulvinus cells, but is wholly centered in the latter; (3) if the inflection movement is considerable, the white cushion of the pulvinus shows a visible change from white to a dull leaden green color; (4) when the more refrangible rays are cut off by a color screen the stimulus is removed, and then

neither the heat rays nor the less refrangible light rays cause closure. The above experiments then indicate that by the paraheliotropic movement leaflets are protected from the intense action of the blue-violet rays, and for this end all the leaflets on any one leaf need not move through the same angle." "These observations emphasize the view already expressed by several investigators that orange, yellow, and green screens to the protoplasm, whether in the form of pigmented walls, of pigmented cell sap, or of chlorophyll are of a protective character, and permit the normal functions to be carried on unimpeded by the action of the more intense blue-violet rays. But while such pigments are specially effective, the writer would suggest a similar function for the thick, highly cuticularized epidermis that covers so many desertic plants, or plants that grow in places exposed to intense sunlight. One can easily prove by experiment that on a hot day a thin sheet of white paper considerably reduces the light intensity. A piece of *Opuntia* epidermis similarly obstructs the light rays, and even though the heat rays pass, we have seen that up to 40–43° C. no injurious effect follows to many plants. It might further be pointed out, as Wiesner has already done, that the hair covering on the leaves of certain plants will contribute to the same end." The location of the movement in the pulvinus was determined by shading this organ from the direct action of the sun by narrow strips cut from an oak leaf. When the pulvini were thus shaded, leaflets that were inflexed 45 to 50° re-expanded in a few minutes so as to form an angle of only 5 to 10°. The time required to effect this change of position was only $1\frac{5}{8}$ minutes in *Cassia nictitans* and $2\frac{1}{4}$ to $2\frac{5}{8}$ minutes in *C. chamæcrista*, depending on the age of the leaf. Strips of mica of like weight caused no movement."—ERWIN F. SMITH.

Chalazogamy in Juglans regia.—Some years ago in *Casuarina* a peculiar genus of Australian and East Indian trees, dicœcious, bearing aments, having the foliage reduced to scales, and superficially resembling Equisetaceæ, Dr. Treub discovered that the pollen tube does not enter the ovule by way of the micropyle but finally reaches the egg-cell by growing through the chalaza. This peculiar and altogether anomalous method of fertilization led him to found a distinct group of Angiosperms, sub-division *Chalazogamia* equal in rank with subdivision *Porogamia*, including the rest of the Dicotyledons and Monocotyledons. Subsequently, Dr. Nawaschin, of Kiew, Russia, discovered that the same thing occurs in the Betulaceæ, and now in Ein neues Beispeil der Chalazogamie (*Botanisches Centralblatt*, Bd. 63, 1895, pp. 353–357) the same author states that he has found chala-

zogamy in *Juglans regia.* The large ovule is anatropous. The placenta fills the ovary and frequently fuses with it. From the sides of the placenta develop two peculiar wing-like growths projecting somewhat above the base of the ovule. The pollen tube is strictly intercellular in its growth as in the other Chalazogamia. After the tube has penetrated the stigma and grown through the style, it enters the tissue of the ovary near the canal of the style but without entering its cleft or penetrating the micropyle. During its further growth, in the wall of the ovary, the tube turns to right or left and passing through the wing-like placental growths enters the top of the placenta and from here grows through the chalaza into the nucellus and to the embryo sack. During nearly its entire growth the tube sends out projections and in the chalazal region these become branches which give to the nucellus a veined appearance as if penetrated by a number of distinct pollen tubes. Several of these branches finally reach the embryo sack and surround it on all sides. The author detected the male nucleus, not only in the pollen tube, but also inside the embryo sack. At this time there was in the embryo sack neither an egg apparatus nor a differentiated egg. Besides the antipodal cells, separated from each other by a cellulose membrane, there were only some free nuclei on which devolved the rôle of the female apparatus. These appearances can hardly be explained otherwise than by supposing that the male nucleus fuses with one of the female nuclei to form the egg-cell. In these particulars *Juglans* (also *Corylus*) appears to be related to *Gnetum*, the developmental history of which has been studied critically of late by Geo. Karsten (Cohœn's *Beiträge*, VI). The author now attributes chalazogamy to the inability of the pollen tube to grow through empty spaces, and regards these plants as standing on the threshhold of the angiospermous world. To him they represent transition forms between Gymnosperms in which the pollen tube has an intercellular growth and Angiosperms in which it grows through the mycropyle.—ERWIN F. SMITH.

ZOOLOGY.

Variation in Halicystus octoradiatus.—Among 154 specimens, according to a recent paper in the *Quarterly Journal of Microscopical Science*,[1] Mr. E. T. Brown found 120 normal and 34 abnormal

[1] Vol. XXXVIII, pp. 1–9, Pl. I.